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International Biometric Performance Conference, March 2-4, 2010

# Large-Scale Biometric Testing at the FBI

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# Background: Moving from IAFIS to NGI

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- **FBI Mission Evolution**

- Changed since IAFIS went live in 1999
- Successful criminal, as well as, non criminal justice missions



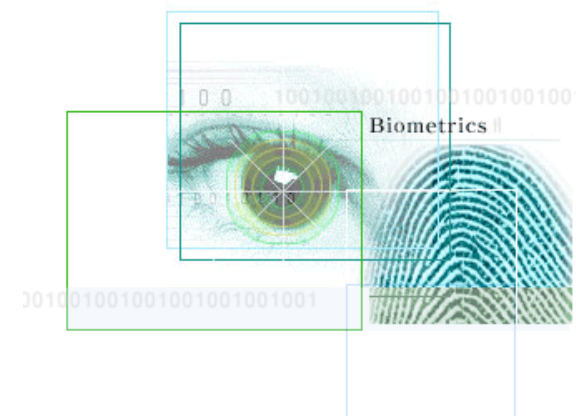
- **Focus on Technology Advancements**

- Improved biometric services
- Expanded support for new counterterrorism mission
- Continually added enhancements to the system
- Continually seeks technological advancements to improve the system



- **Changing Business Needs**

- New legislation requires increased background checks
- Increased noncriminal justice fingerprint background checks
- Department of Homeland Security support





# NGI Drivers for Large-Scale Testing

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- **Advanced Fingerprint Identification Technology (AFIT)**
  - Fewer missed identifications
  - Faster response times
  - Greater throughput
  - Determine accuracy of latent fingerprint matching
  - Slap fingerprint segmentation
- **National Palm Print System (NPPS)**
  - Establish national palm print repository against which latent prints may be searched
  - Solidify the knowledge of the similarities and differences between fingerprint and palm print matching
- **Enhanced IAFIS Repository (EIR)**
  - Evaluate state-of-the-art as other modalities are integrated
  - Interstate Photo System (IPS)
    - Faces, Scars, Marks, and Tattoos
  - Iris
  - Multi-biometric fusion
- **All of the above necessitate large-scale testing efforts**



# What is a Trade Study?

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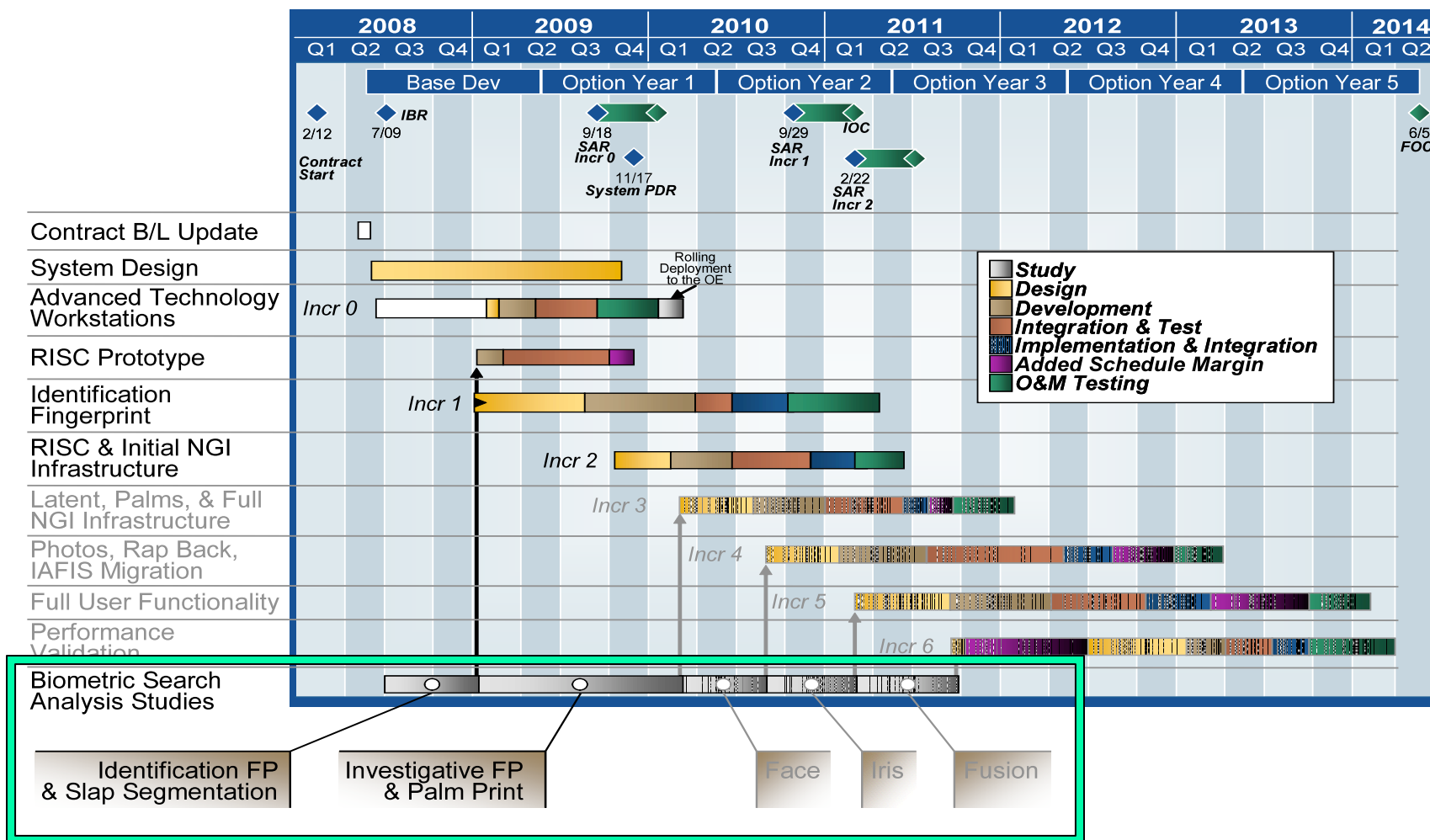
- Trade Studies were intended to provide clarity through an assessment of market capabilities resulting in high confidence investment decisions
- Focused on evaluating the ability of biometric algorithms provided by vendors to meet select NGI performance requirements
  - Accuracy, workload, capacity, response time, availability, and scalability
- The onus to conduct NGI Trade Studies is on the NGI integrator
- Trade Studies occur Just in Time (JIT) to support development activities for a given biometric technology





# NGI Implementation Schedule

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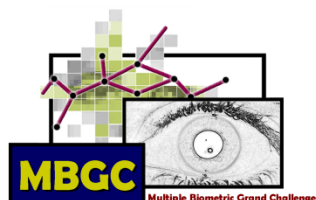




# NIST Evaluation and Challenge Events

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Biometric Modality	Evaluation / Challenge	Year(s)
Multi-Biometric	Multiple Biometric Evaluation (MBE)	2009-201?
	Multiple Biometric Grand Challenge (MBGC)	2008-201?
Fingerprint	Evaluation of Latent Fingerprint Technology : Extended Feature Sets (ELFT-EFS)	2009-201?
	Evaluation of Latent Fingerprint Technology (ELFT)	2007-2008
	Slap Fingerprint Segmentation Evaluation II (SlapsegII)	2008-201?
	Minutiae Exchange II (MINEX II)	2007-201?
Face	Face Recognition Vendor Test (FRVT)	2006-2007
	Face Recognition Grand Challenge (FRGC)	2004-2006
Iris	Iris Exchange (IREX)	2008-201?
	Iris Challenge Evaluation (ICE)	2005-2006



# Data Preparation

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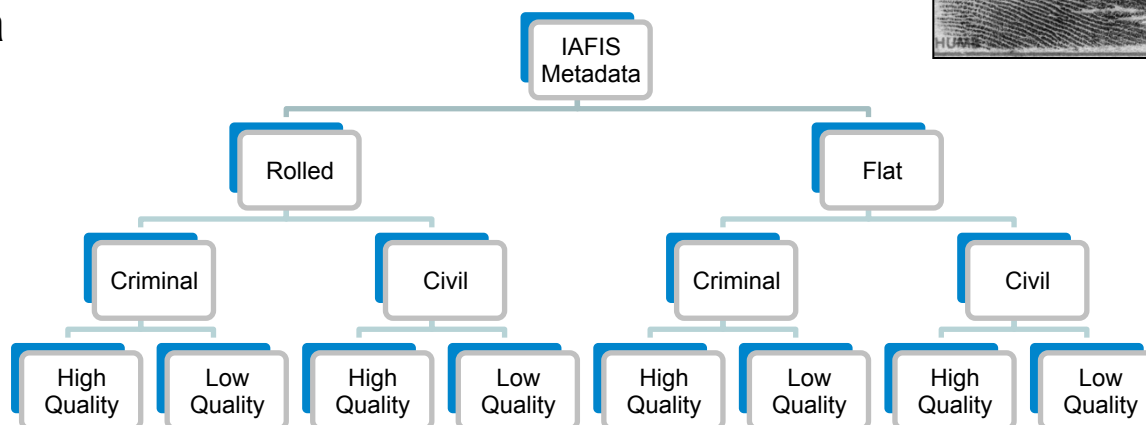
- The diversity of large-scale testing drivers requires the development of a variety of datasets which serve as the foundation of testing
- As part of datasets development the following considerations needed to be addressed
  - Ensure no vendor bias exists in data
  - Ensure sufficient quantities of data exist to support system performance and accuracy projections
  - Ensure adequate amount of data can be made publicly available
  - Ensure adequate amount of data remains sequestered
  - Ensure data is operationally representative
- Led to the recent preparation of multiple test beds
  - Rolled and Flat Fingerprint - Platinum Data Repository (PDR)
  - Latent Fingerprints and Palm Prints
  - Facial Images



# Data Preparation for NGI Development

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- **Rolled and Flat Fingerprints - Platinum Data Repository (PDR)**
  - FBI GFI to be provided to the NGI Integrator in support of the NGI Trade Studies.
- Selection of the PDR based on an analysis of IAFIS transaction metadata over a year long period
  - All days between Nov. 11, 2007 and Dec. 31, 2008
  - 45.9M samples, an average of 111K per Day
  - Idents 10.5M, Nonidents 28.9M
  - 21.8GB of ASCII data
  - Rolled
    - Idents 10.25M
    - Nonidents 15.63M
  - Flat
    - Idents 309K
    - Nonidents 13.37M







# Data Preparation for NGI Development

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- A subset of the PDR was used to support Identification Fingerprint Search and Slap Segmentation testing
  - IdFP search set (IdFP 600K) totaled 598,062 probes (299,810 rolled, 298,252 flat)
    - The number of search probes with mates in the repository was 269,323 (149,297 rolled, 120,026 flat)
    - Total of 289,880 true matches in the test set (150,843 rolled, 139,037 flat)
  - Final IdFP repository size was 3,199,683 subjects.
    - Including required mates from search set
    - The IdFP repository contained 51.3% Criminal submissions and 48.7% Civil
  - RISC search set (RISC 160K) totaled 159,446 probes (151,446 two finger, 4,560 rolled tenprint and 3,440 flat tenprint).
    - The number of search probes with mates in the repository was 83,210 (79,134 two finger, 2,284 rolled tenprint, 1,792 flat tenprint).
    - Total of 100,384 true matches in the test set (95,855 two finger, 2311 rolled tenprint, 2210 flat tenprint).
  - Final RISC repository size was 3,199,666 subjects
    - 69% rolled and 31% flat; 95% tenprint and 5% 2 print.
  - Slap Seg 15,558 (7779 subjects \* 2 slaps per subject) 2 inch and total of 32,625 (10,875 subjects \* 3 slaps per subject) 3 inch

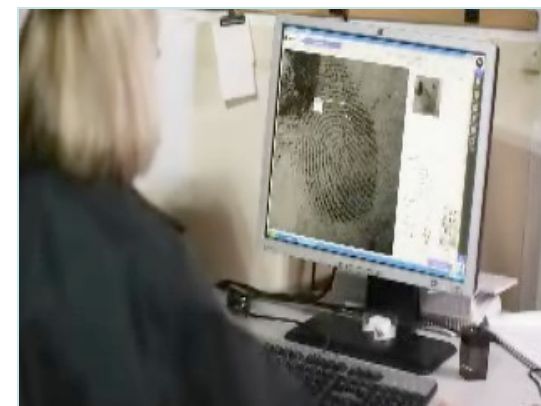




# Role of Human Capital in Data Preparation

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- Human capital investments for data preparation and post-test analysis
  - Manual resources were applied to substantially improve utility of datasets
    - Ground truthing for slap segmentation tests
    - Assistance in miss analysis
    - Analysis of unexpected results
    - Latent examiner expertise
    - Ensure availability of support tools



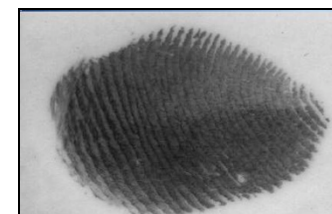


# Data Preparation for Latent Testing

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- Baseline dataset collected from multiple sources including both operational and laboratory environments
- Largest latent fingerprint dataset with verified by examiners (FBI and contractors) including extended markup data

Source Name	# Latent Images	# Distinct Fingers	# of Subjects	Description
Casework 1	372	372	272	Operational casework images
Casework 2	165	165	163	Operational casework images
WVU	446	446	383	Laboratory collected images
FLDS	93	93	15	Laboratory collected images
MLDS	38	38	4	Laboratory collected images
Totals	1,114	1,114	837	Laboratory collected images (small set of publicly releasable images for examples in reports)

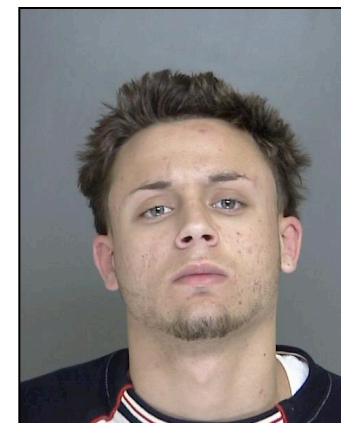




# Data Preparation for Face Testing

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- Existing FBI data holdings
  - 7.1 million EBTS submissions
  - 10.8 million photos
  - Assessing JABS extract
  - Include scars, marks, and tattoos
- Building a Face Test Set
  - NIST Special database of deceased individuals
  - 2.4 million EBTS submissions
  - 3.5 million face images
  - Sorted by capture angle
    - $\approx$  2.6M Frontal
    - $\approx$  0.9M Profile





# Summary

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- **Identification Fingerprint and Slap Segmentation Solution**
  - Lockheed Martin completed the independent trade study
  - Lockheed Martin awarded a subcontract to the Alexandria, Virginia based MorphoTrak
- **Identification Fingerprint Search Capability**
  - Supports increased accuracy of fingerprint search results and provides better support for processing flat and less than ten fingerprint submissions

## •Tenprint Performance Comparison

Performance Metric	Current IAFIS	NGI Objective (Increment 1)
Tenprint True Match Rate	92%	99%
Tenprint False Match Rate	1.15%	0.30%
Processing Capacity (Daily Throughput)	150K	299K
Storage Capacity (Repository Size)	100M	157M

## •Electronic Tenprint Response Times

IAFIS	Criminal	Civil
Response Time	2 hours	24 hours
NGI	Criminal	Civil
High	10 minutes	15 minutes
Routine	30 minutes	2 hours
Low	24 hours	24 hours
Non-Urgent	15 days	15 days

•80% better accuracy at three times the overall matching capacity at IOC scalability to accommodate greater capacity at FOC





# Summary

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- NGI latent fingerprint and palm print technical evaluation is complete
- NIST ELFT-EFS preliminary report delivered on 01.26.10
- NIST MBE Still Face Track currently accepting SDKs
- NGI Face Trady Study approach and planning underway